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(54) Web-rolling machines

(57) A method of operating a web-rolling machine, e.g. a paper calender, comprising at least two elastic work rolls (5, 6), each movable between a working position (A) and an open position (B), and at least one hard base roll (4), comprises holding roll (5) in the working position and driving roll (6) in the open position at a low speed of rotation, until roll (5) is to be replaced, when roll (6) is brought approximately to the same peripheral speed as the base roll (4), then moved into its working position (A) and, at the same time, roll 5 is moved into its open position (B).

Fig.1

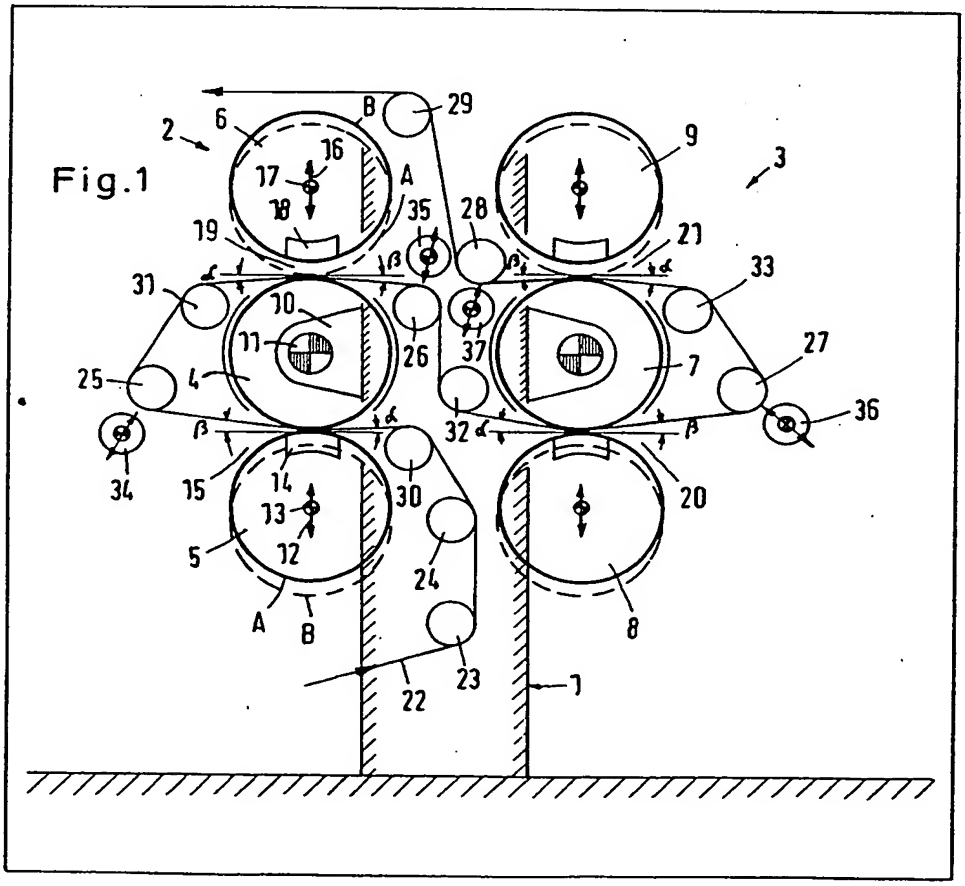

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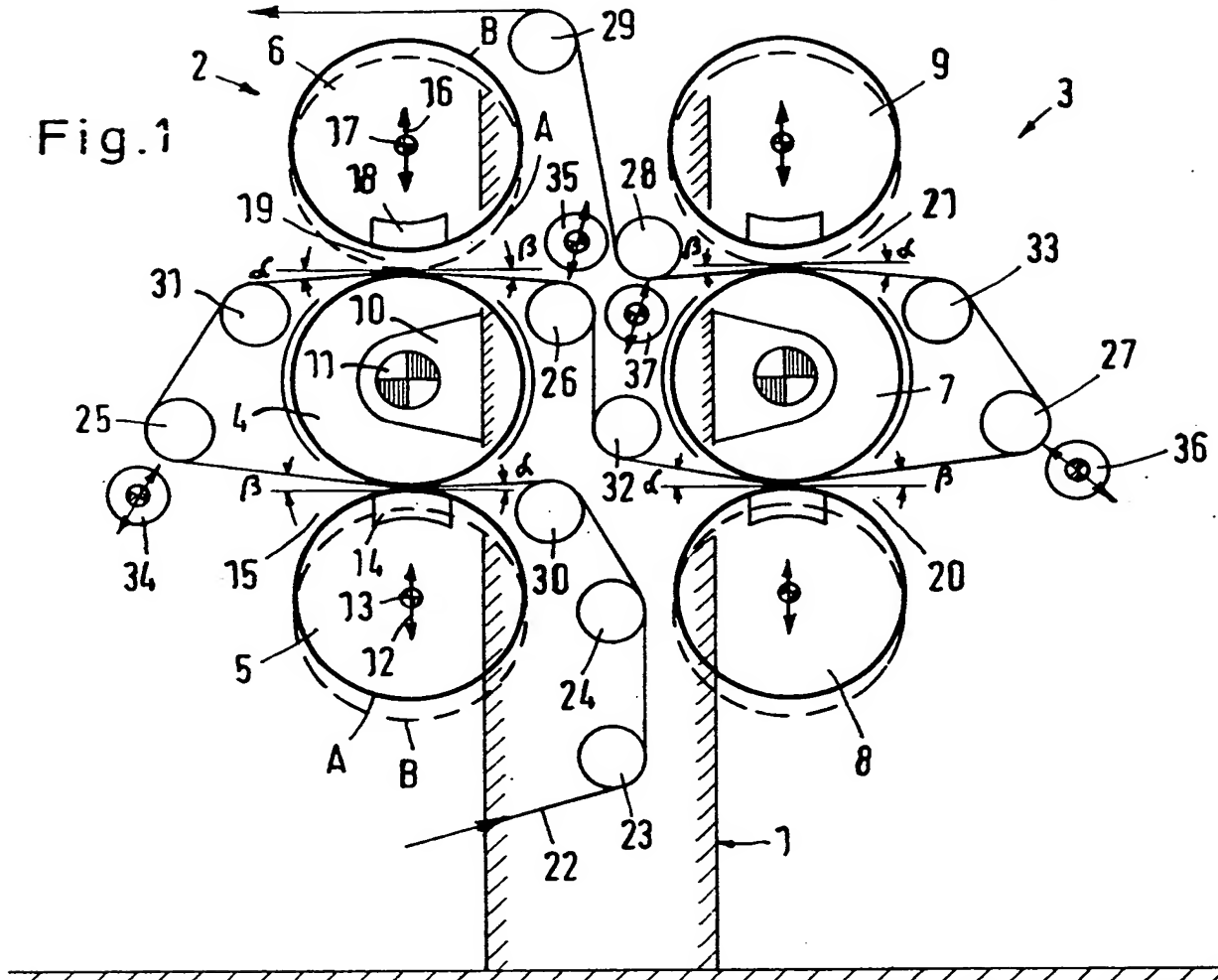
Fig.1



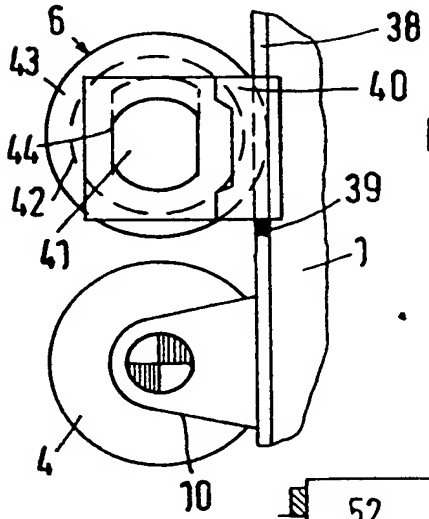


Fig.2

Fig.3

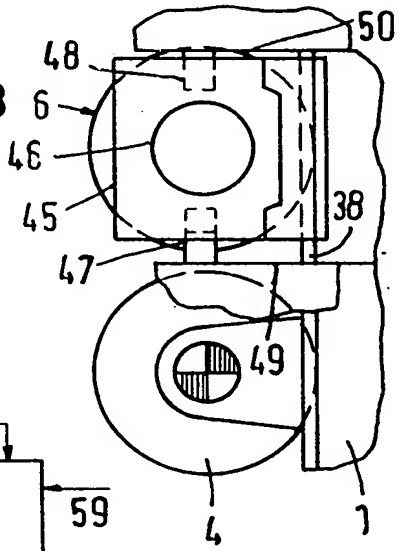
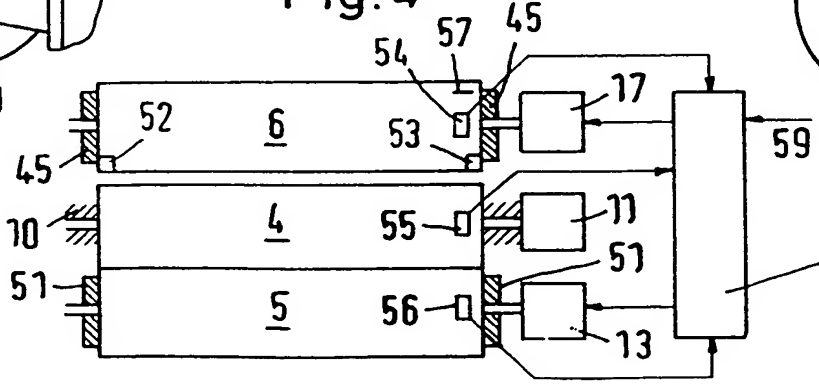


Fig.4



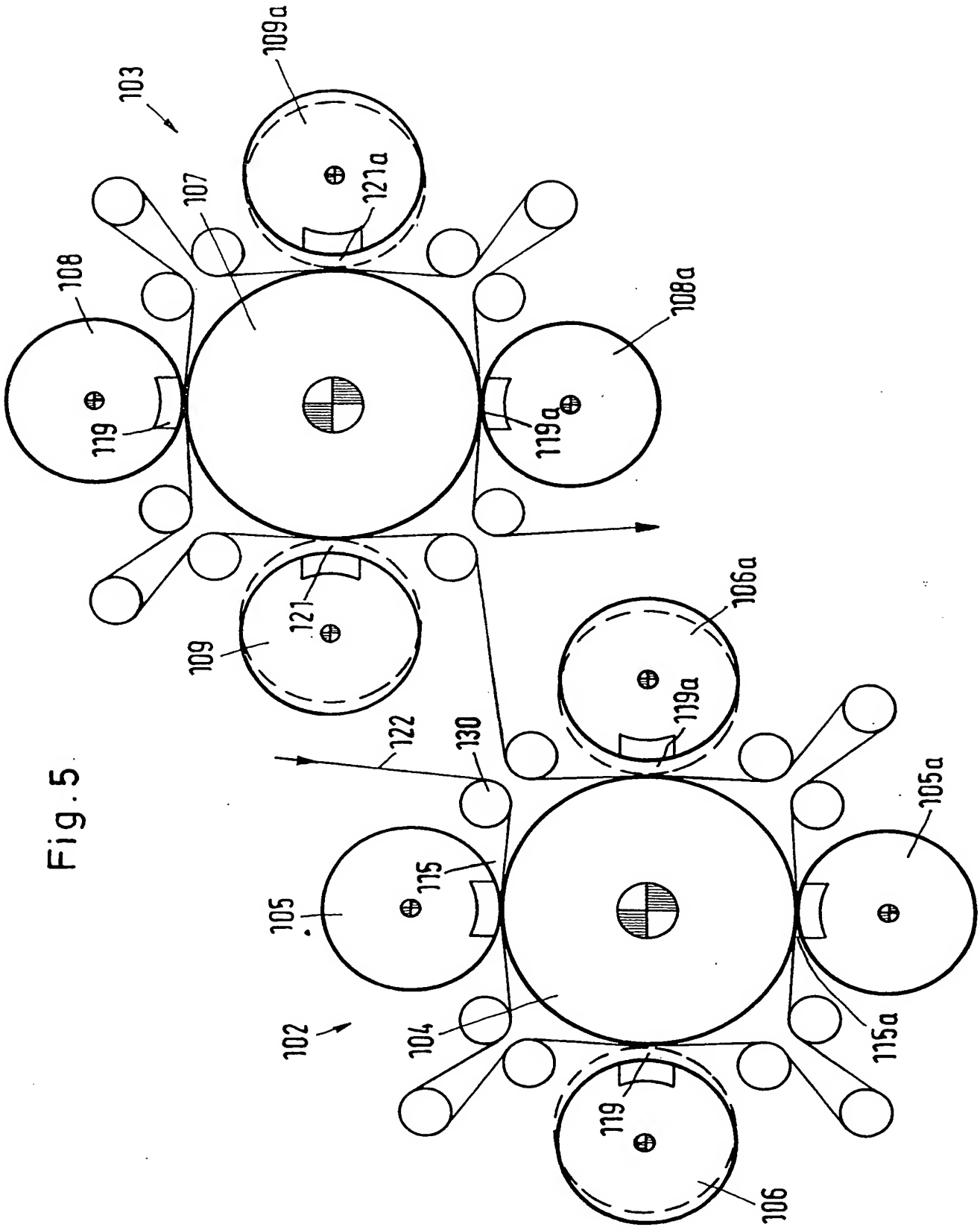
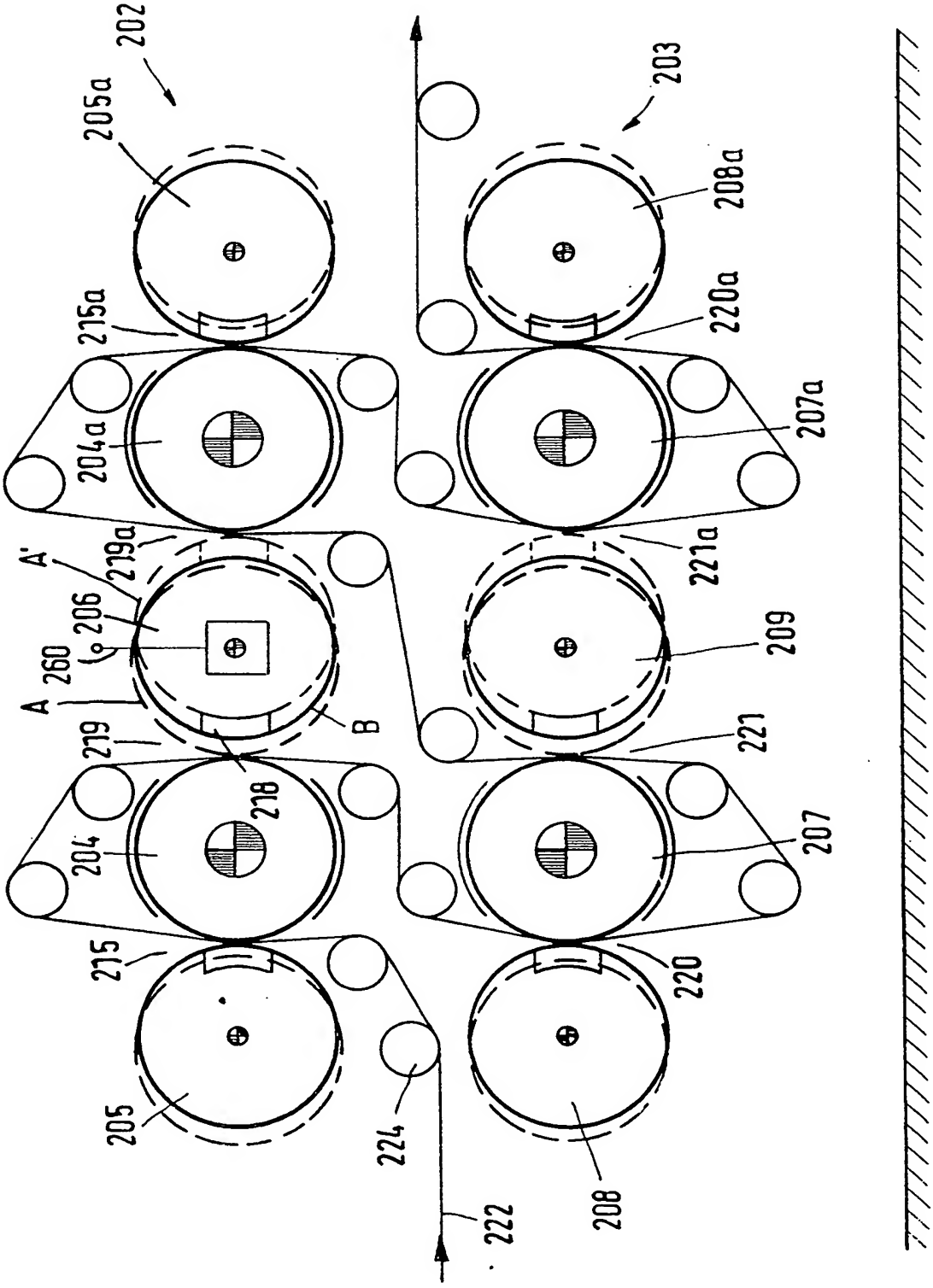

103
109a
121a
107
108
108a
119
119a
109
121
106a
119a
122
130
105a
105
115
102
104
115a
119
106

Fig.5

Fig.6


202
205a
215a
204a
219a
A'
206
260
A
219
218
204
215
205
224
222
203
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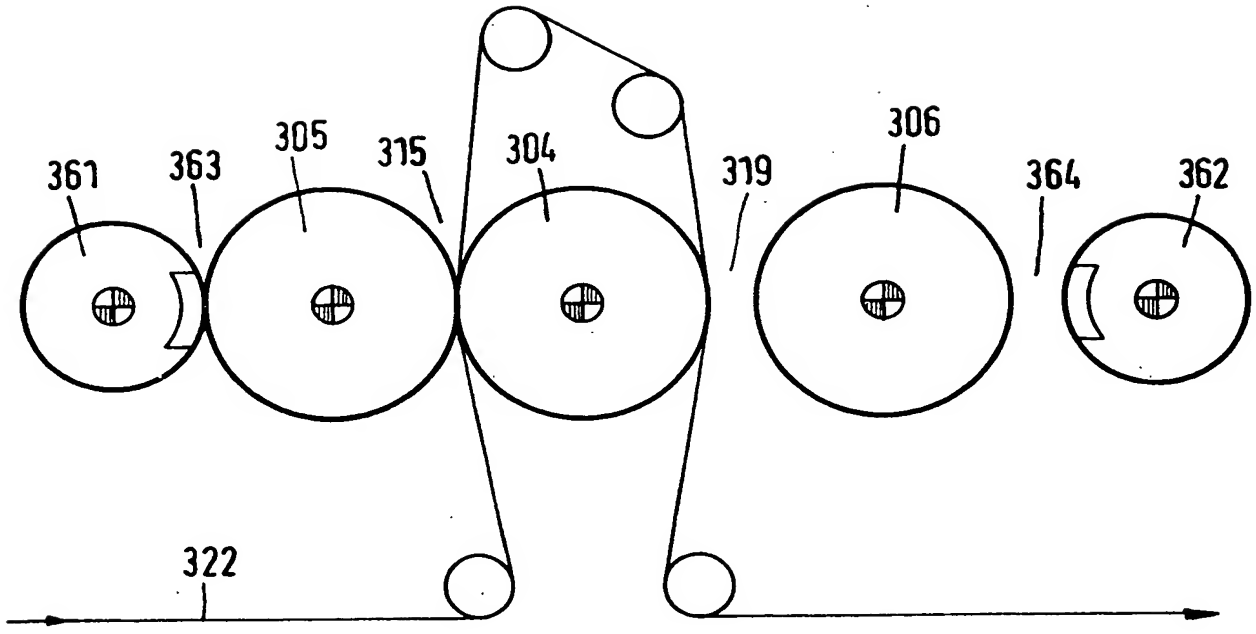
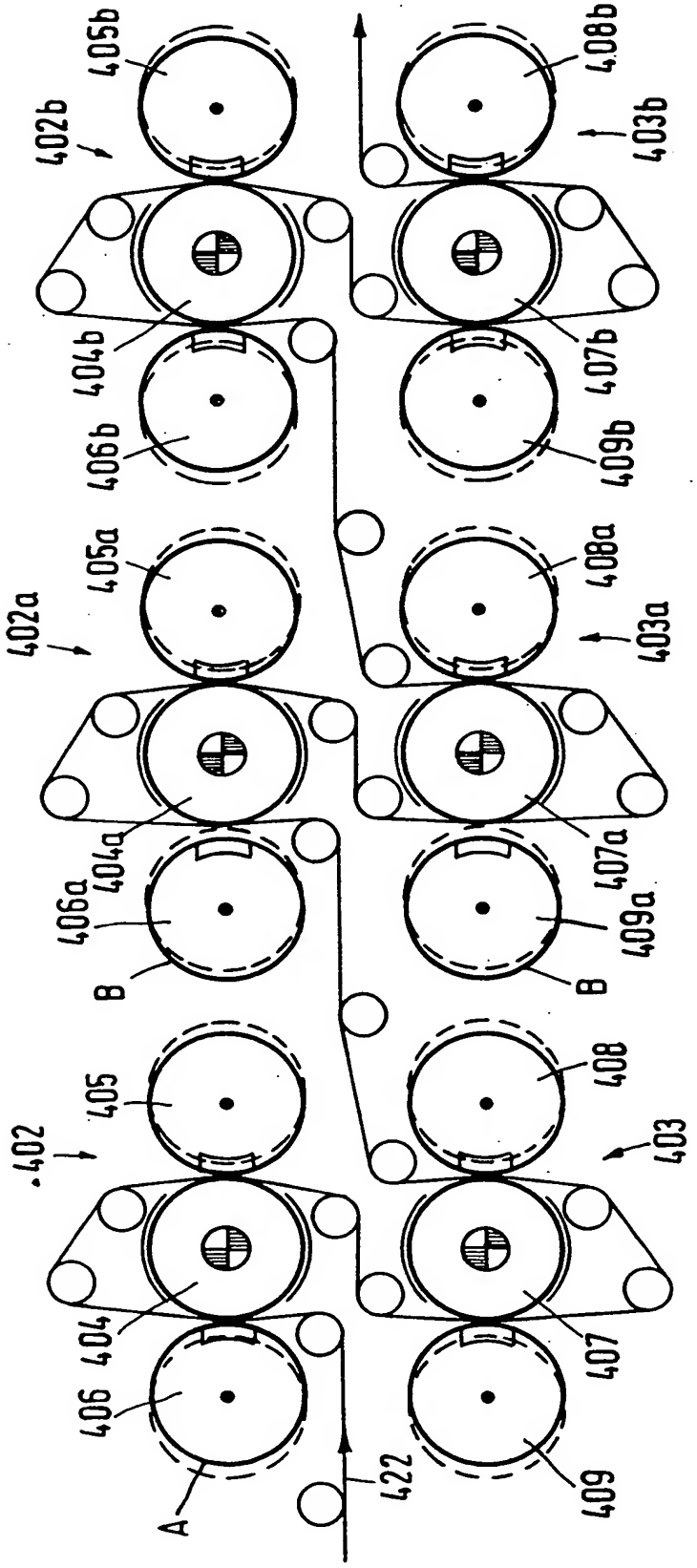
220a
207a
221a
209
221
207
220
208
B

Fig.7

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408a
402a
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409a
B
B
405
408
402
403
404
407
406
409
A
422

Fig.8

SPECIFICATION

Improvements relating to web-rolling machines

The invention relates to a method of operating a web-rolling machine, particularly a calender for webs of paper and other materials, which has at least one hard base roll, the temperature of which is preferably controllable, at least two elastic work rolls, each of which forms a nip with a base roll and which is adapted to be moved by means of an adjusting device between a working position, in which it is pressed against the base roll, and an open position, in which it is spaced from the base roll, and to be brought by means of an adjustable drive to substantially the same peripheral speed as the base roll; and guide and directing members which guide the web in such a manner that where a work roll is in the open position the web merely rests on the base roll; and to a rolling machine for carrying out this method. Such a method is hereinafter referred to as of the kind described.

In one known paper calender (US Patent Specification No. 3,254,593), which is connected directly to a paper-making machine, the web of paper passes through two units, each of which comprises one base roll and two work rolls disposed diametrically opposite to one another. The web is therefore treated in four nips, one side of the web lying against the heated base roll in the first two nips and the other side of the web lying against the heated base roll in the other two nips. The respective contact surfaces are different. The work rolls are held in pivotable bearings and by means of pneumatic pressure transducers can be pressed out of their open position into their working position against the base roll. The work rolls are driven by means of a belt drive and an adjustable clutch by the base roll shaft. By engaging the belt drive and adjusting the clutch, the work rolls can be approximately synchronised with the peripheral speed of the base roll.

The base roll is called hard because it is provided with a shell of chilled cast iron, steel, or other metallic material having a hard surface. The work rolls are called elastic because they are provided with an elastoviscous coating material, for example paper. The life of an elastic roll of this kind is substantially shorter than that of a base roll, because of general wear or damage by the web material. When in the known machine an elastic work roll is damaged or worn, the calender must be stopped so that the work roll concerned can be changed. This entails a stoppage of production lasting from 30 minutes to a few hours, in addition to the expense of restarting the machine.

The object of the invention is to provide a method of the kind described, in which the servicing or replacement of an elastic work roll can be achieved without interrupting operation and without substantial variation of the quality of the web material.

According to the invention, this object is achieved by virtue that the first of two work rolls, which in their working position effect substantially the same treatment of the web, is held in the working position and the second is held in the open position as a reserve roll, the second work roll being driven at a low speed of rotation, and that, for the purpose of servicing or replacing the first work roll, the second work roll is brought approximately to the same peripheral speed as the base roll and is then moved to its working position and, substantially simultaneously, the first work roll is moved into its open position.

Owing to the fact that one of the work rolls is held in the open position during normal operation, it can, as a reserve roll, very quickly take over the function of the work roll which was hitherto in the working position. Because the reserve roll does not need to be brought to the same position as the work roll which is to be replaced, the taking over of the function of the work roll is effected very quickly, so that operation can be continued without interruption. Since the two work rolls both effect substantially the same treatment of the web, the change of rolls does not lead to a variation of the quality of the web material. Because the second work roll is synchronised with the peripheral speed of the base roll, there is no danger of the web tearing or being damaged. The work roll provided as a reserve roll rotates slowly in the open position, so that deformation of this work roll through the force of gravity, for example sagging, is prevented and its surface is uniformly exposed to ambient conditions, for example the temperature of the base roll. A very low speed of rotation is sufficient for this purpose, and this speed may be lower than 1% of the operating speed and even lower than the speeds customary for the introduction of the web material.

The first and second work rolls used are preferably work rolls associated with the same base roll. This provides great certainty that the work rolls will effect roughly the same treatment of the web, particularly in the case of base rolls whose temperature is controlled.

It is very advantageous for a replacement first work roll to serve as reserve roll after the exchange of rolls. In this way continuous operation can be achieved, even if a plurality of work rolls have to be changed one after the other. In the simplest case this means that two work rolls are used alternately as reserve rolls. It is however also possible to provide a second work roll, serving as reserve roll, for a plurality of first work rolls which are in the working position, and then to replace with the reserve roll the work roll which is first damaged or worn.

The second work roll is preferably held ready for operation in the open position. All connections necessary for operation are accordingly provided. The exchange of rolls can therefore take place very quickly without detrimental effect on the web of material.

If the web bears with one side against at least one first base roll and with its other side against at least one second base roll, it should be ensured that both for the first and for the second base roll at least one work roll is held in the open position

as reserve roll. It is thereby ensured that when an exchange of rolls is made both sides of the web will continue to be treated in the same manner.

A rolling machine for carrying out the new method is characterised in that at least one of two work rolls, which in their working position effect substantially the same treatment of the web, is provided, for the purpose of serving as reserve roll, with a drive which has in addition a slow speed independent of the driving speed of the other work roll and of the base roll. The drive required for achieving synchronism is additionally used for effecting the slow rotation of the work roll held in the position of readiness.

In this connection it is particularly advantageous for the drive to be in the form of a variable speed motor associated only with the work roll in question. This motor can be operated with the aid of a simple controller in such a manner that the desired speeds are achieved.

In particular, the drive may have a controller to which the peripheral speed of the work roll is fed as an actual value and to which either a constant value for the slow speed or the peripheral speed of the base roll is fed as desired value. Contactless sensors sensing markings on the periphery of the rolls may for example be used for determining the peripheral speed.

The adjusting device may be provided with means having distance sensors for the purpose of guiding the work roll parallel to the base roll when it changes over from the open position to the working position. The adjusting device is therefore controlled in such a manner that the second work roll comes into contact with the base roll simultaneously over its entire length. This also contributes towards effecting the exchange of rolls without substantial impairment of the web of material.

The guide and directing members are expediently disposed in such a manner that the web has the same area of contact on the base roll in each of the two work roll nips. Since the size of the contact surface also has an effect on the properties of the web of material, for example when the temperature of the base roll is controlled, it is also ensured in this manner that the properties of the web will be identical after the exchange of rolls.

In this connection it is advantageous for the guide and directing members to be so disposed that in each of the two work roll nips the entry angles and exit angles of the web are identical to one another. The greater the symmetry in the nip, the more accurately will it be possible to maintain the quality of the web. The sum of the entry and exit angles should at most be equal to 20°. The contact surface is accordingly relatively small. The effect of contact with the base roll on the web portion situation in the open nip is therefore insignificant.

The guide and directing members are preferably disposed in the same arrangement upstream and downstream of the two work roll nips. The identical arrangement give rise to the desired identical conditions in the two nips.

It is advantageous to ensure that each of the two work nips is preceded by an adjustable guide roller around which the web is wrapped over an angle of less than 90°, and which applies to the web control and restoring forces directed transversely to the movement of the web. Guide rollers of this kind, such as are known for example from German Patent Specification No. 2,033,740, apply a transverse adjusting action to the web. Since they are situated directly upstream of the nip, the web is cleanly introduced into the nip. The angle of wrap of less than 90° ensures that the effectiveness of the guide rollers is not impaired by frictional forces.

A fixed directing roller may be disposed downstream of both work roll nips. This defines the exit angle and effects a deflection of the web.

Each of the directing rollers, in conjunction with a respective inserter roller with which it is adapted to be pressed into contact, may form a pair of draw rollers for the feeding of the web. In this way the downstream directing rollers take over an additional function.

In a rolling machine in which two work rolls disposed diametrically opposite one another are associated with one base roll, it is advisable for both work rolls to have a drive providing a low speed. These work rolls can then be used alternately as reserve rolls.

In an alternative, three or more work rolls, of which at least one has a drive providing a low speed, are associated with one base roll. In the simplest case one reserve roll is therefore provided for two or more work rolls forming a nip. However, for one base roll it is also possible to provide a plurality of uniquely associated pairs of first and second work rolls.

In another alternative, provision is made to dispose between two base rolls, each of which is provided with at least one work roll of its own, another common work roll which has a drive providing a low speed and which is adapted to be pushed out of a central open position towards either one of the two base rolls. Here one reserve roll can be provided for two base rolls.

Each of the work rolls is advantageously provided with a deformation control device. This ensures uniform treatment of the web of material over the entire width. When a common work roll in which the deformation control device is installed is used, the control device should be rotatable through an angle of 180°.

An alternative consists in providing a deformation control and pressing roller on that side of each of the work rolls which is remote from the base roll. This results in work rolls of simpler construction.

The web should pass directly through all the work roll nips of a base roll in succession. This results in relatively short web portions inside the rolling machine. In the case of base rolls having only two work rolls it is ensured that when an exchange of rolls is made the sequence of the treatment stages will remain identical.

In a rolling machine having at least one first base roll, against which one side of the web lies, and at least one second base roll, against which the other side of the web lies, it is advisable to provide at least one work roll, whose drive provides a low speed, for each of the first and second base rolls. At least one reserve roll is accordingly associated with each side of the web, so that conditions remain identical when an exchange of rolls is made.

It is advantageous for one work roll to be disposed in the path of the web between at least two first work rolls. The second work roll can then replace one of the first work rolls without any great differences occurring in the treatment sequence.

The invention is further explained below by preferred examples which are illustrated in the accompanying drawings, in which:—

Figure 1 shows schematically a first example;

Figure 2 is a schematic elevation of a first form of construction of an adjusting device;

Figure 3 is a schematic elevation of a second form of construction of an adjusting device;

Figure 4 is a schematic view of a roll arrangement;

Figure 5 shows another example;

Figure 6 shows a third example;

Figure 7 shows a fourth example; and,

Figure 8 shows a further example.

In the calender shown in Figure 1 two units 2 and 3 are provided in a calender stand 1. The unit 2 comprises a hard base roll 4, a first elastic work roll 5 and a second elastic work roll 6. The unit 3 comprises a hard base roll 7, a first elastic work roll 8 and a second elastic work roll 9. The base roll 4 is mounted in bearings 10 fixed in the stand and is provided with its own drive motor 11 (Figure 4). The work roll 5 is adapted to be moved either into a working position A shown in the drawing, or into an open position B shown in broken lines, by means of an adjusting device 12 indicated by an arrow. It has its own drive motor 13 and is provided with a deformation control device 14. In conjunction with the base roll 4 it forms a nip 15. The second work roll 6 is likewise adapted to be moved either into an open position B, as shown in the drawing, or into a working position A shown in broken lines, with the aid of an adjusting device 16 indicated by an arrow. The second work roll 6 likewise has its own drive 17 and is provided with a deformation control device 18. In conjunction with the base roll it forms a nip 19. The construction of the unit 3 is similar. Here the nip 20 is formed between the first work roll and the base roll 7, and the nip 21 is formed between the second work roll 9 and the base roll 7.

The rolls are shown in solid lines in their present operating positions. The first work rolls 5 and 8 are therefore adjusted against the respective base rolls 4 and 7, so that the press nips 15 and 20 are formed. The second work rolls 6 and 9 on the other hand are spaced at a distance from the base rolls 4 and 7, so that the nips 19 and 21 are open. For the purpose of transporting a web of paper 22 through the calender, directing rollers 23 to 29, mounted in fixed bearings, and adjustable guide rollers 30 to 33 are provided, the latter being for example anticrease rollers or lateral adjusting rollers, around which the paper web 22 is wrapped over an angle of less than 90°. The upstream guide rollers 30 to 33 have in all cases the same association with the respective nip 15, 19, 20 or 21. The downstream directing rollers 25 to 28 also have the same association with the respective nip. Consequently, it is ensured in all the nips that the same entry angle α and the same exit angle β will exist, and that the web 22 will have the same contact area on both sides of each base roll 4 and 7. Each of the directing rollers 25 to 28 has associated with it a drivable inserter roller 34 to 37 which can be pressed against the respective directing roller in the direction of the arrow, so that a pair of draw rollers is formed which can be used for feeding the web.

Figure 2 shows one form of construction of the adjusting device 16 for the work roll 6. A roller bearing 40 is fixed on a guide 38 of the calender stand 1 by means of a stop 39, for example by an hydraulic cylinder (not shown) acting from above. Two such bearings 40 hold a rotationally fixed bearer 41. On the latter, bearings 42 for a roll shell 43 are vertically displaceable by means of guide 44 when the pressure transducers of the deformation control device 18 are correspondingly operated. An arrangement of this kind is shown for example in British Patent Application No. 2,070,090.

Another form of construction of the adjusting device 16 is shown in Figure 3. Here two roller bearings 45, in which a shaft 46 of the work roll 6 is mounted directly, are provided with two short-stroke cylinders 47 and 48, whose pistons can be respectively supported on supporting surfaces 49 and 50, which are fastened on the casing. Short-stroke cylinders of this kind are for example described in British Patent Application No. 2,088,429. Through selective operation of these short-stroke cylinders the two positions A or B can be assumed. Corresponding arrangements are provided for the respective bottom work rolls. The first work roll 5 can for example be held in bearings 51 adjustable by means of short-stroke cylinders.

According to Figure 4, two distance sensors 52 and 53 serve to operate the adjusting device 16, that is to say the hydraulic cylinders 47 and 48, in such a manner that the work roll 6 can be guided accurately parallel in its movement towards the base roll 4.

Contactless sensors 54, 55, 56 allocated to the three rolls 4, 5 and 6 sense markings 57 on the respective roll, whereby in a computer 58, in the form of a controller, the peripheral speeds of the rolls are first determined and the drive motors 13 and 17 are adjusted in dependence thereon. In particular, the drive motor 13 is operated in such a manner that the work roll 5 and base roll 4 have

exactly the same peripheral speed or that there is a small, accurately defined difference. The motor 13 is driven at a very low speed as long as the second work roll 6 is in the open position B, for which purpose at the input 59 a corresponding desired value is preset, which is compared with the actual value of the peripheral speed of this roll. When however the second work roll 6 is to be brought into the working position A, this actual value of the peripheral speed is compared with a desired value which corresponds to the peripheral speed of the base roll 4, and the speed of rotation of the roll 6 is then raised until synchronism is substantially achieved.

If it is found during operation that the first work roll 5 is damaged, the speed of rotation of the second work roll 6 held in readiness is first raised to synchronous speed with the aid of the drive 17. The work roll 6 is then moved against the base roll 4 by means of the adjusting device 16, and at the same time the first work roll 5 is lifted away from the base roll 4. The work roll 6 therefore takes over practically simultaneously the function of the work roll 5, so that the treatment of the web material undergoes practically no interruption at all in this unit. The work roll 5 can then be removed, taken away and replaced by a new work roll. The latter can then be brought into the open position B of the work roll 5 and there held in readiness as reserve roll.

This exchange of rolls takes place very quickly because the second work roll 6 was mounted ready in the open position, that is to say was connected to the appertaining pressure transducer system, to the energy supply and control systems of the deformation control device, and to the drive. The processing conditions for the treatment of the web are not affected, because the geometry of the web in the two nips 15 and 19 is completely identical and the work roll 6 is not brought into the working position A until it is rotating in synchronism with the base roll 4.

In the example shown in Figure 5, reference numbers increased by 100 in comparison with Figure 1 are used for corresponding parts. Here two units 102 and 103 are provided. In the unit 102 two first work rolls 105 and 105*a* and two second work rolls 106 and 106*a* are associated with one base roll 104. The first and second work rolls lie in pairs diametrically opposite one another. In the unit 103 two first work rolls 108 and 108*a* and two second work rolls 109 and 109*a* are associated with one base roll 107. They occupy the same positions as in the unit 102. In this way, press nips 115, 115*a*, 120, 120*a* the open nips 119, 119*a*, 121 and 121*a* are formed. The web 122 is alternately guided through one pressing nip and one open nip with the aid of the guide and directing rollers, of which only roller 135 is given a reference numeral. In the units different sides of the web 122 lie against the base rolls 104 and 107 respectively. With this arrangement a large number of press nips can be accommodated in a small space.

In the example shown in Figure 6 reference numerals increased by 200 in relation to Figure 1 are used for corresponding parts. Here a unit 202 comprises two base rolls 204 and 204*a*, to which are allocated one first work roll 205 or 205*a* in each case and one common second work roll 206. Unit 203 comprises two base rolls 207 and 207*a* with one work roll 208 or 208*a* in each case and one common second work roll 209. In this way press nips 215, 215*a*, 220 and 220*a* and also open nips 219, 219*a*, 221 and 221*a* are formed. The web 22 is passed through the calender by means of guide and directing rollers, of which only roller 224 is given a reference numeral, in such a manner that it passes alternately through a pressing nip and an open nip.

In this modification the common work roll 206 can be moved from the open position B to the left into the working position A (shown in broken lines) against the base roll 204, and can take over the function of the work roll 205. It can however also be moved to the right into the working position A' (shown in broken lines) against the base roll 204*a*, and take over the function of the work roll 205*a*. Since in this case deformation control device 218 must be able to work in different directions, a turning device 260 is provided, by means of which the entire carrier of the deformation control device can be turned through 180°.

In the example shown in Figure 7, reference numerals increased by 300 in relation to Figure 1 are used. Here a base roll 304 cooperates with a first work roll 305, which however does not have its own deformation control device but is adapted to be pressed against the base roll 304 by means of a deformation control and pressing roller 361. Similarly, second work roll 306 also does not have its own deformation control device, but can be pressed against the base roll 304 by means of a deformation control and pressing roller 362. The web 322 is here guided through a pressing nip 315 and an open nip 319. It is possible to guide the web through the additional nip 363 also, provided that this also takes place on the opposite side through the nip 364.

In the embodiment shown in Figure 8, reference numerals increased by 400 in relation to Figure 1 are used. In addition to units 402 and 403, there are corresponding units 402*a*, 402*b*, 403*a* and 403*b*. In the units 402, 402*a* and 402*b* one side of the paper web 422 faces corresponding base rolls 404, 404*a*, 404*b*, and in the units 403, 403*a*, and 403*b* the other side of the paper web faces corresponding base rolls 407, 407*a*, 407*b*. The paper web 422 passes alternately through the units. Only in the central units 402*a* and 403*a* are work rolls 406*a* and 409*a* respectively provided, which during normal operation are in the open position B. All other work rolls 405, 405*a*, 405*b* 406, 406*b*, 408, 408*a*, 408*b*, 409 and 409*b* are in the working position A and therefore form press nips, so that intensive treatment of the web is effected. The work roll 406*a* can serve as reserve roll for each of the work rolls of the upper row, and the work roll

409*a* can serve as reserve roll for each of the work rolls of the lower row. Since the web is treated in a total of ten pressing nips, the quality of the web of material is affected only insignificantly if the work rolls which are to be exchanged for one another do not directly follow one another, provided that they are only provided for treating the same side of the web.

As a comparison between Figures 1 and 6 will for example show, the rolls in one unit can be disposed both horizontally side by side and vertically one above the other. However, any other desired arrangements of the rolls in relation to one another is also possible. The temperature control system for the base roll may for example be of the type described in British Patent Application No. 2,017,864. The deformation control device may for example be of the type described in British Patent Application No. 2,083,571. The open nip need not be made too large. It is sufficient for it to have the opening width required for the insertion and passage of the web. The peripheral speed can also be calculated from the circumferential diameter and speed of rotation of the elastic roll, with the aid of a computer. It is most advantageous for all the work rolls to be designed that they can be used as reserve rolls. In some cases, however, it is sufficient to provide only some of the work rolls with the means required for acting as reserve rolls.

CLAIMS

1. A method of operating a web-rolling machine comprising at least one hard base roll; at least two elastic work rolls, each of which forms a nip with a base roll and which is adapted to be moved by means of an adjusting device between a working position, in which it is pressed against the base roll, and an open position, in which it is spaced from the base roll, and to be brought by means of an adjustable drive to substantially the same peripheral speed as the base roll; and guide and directing members which guide the web in such a manner that where a work roll is in the open position the web merely rests on the base roll; characterized in that the first of two work rolls, which in their working position effect substantially the same treatment of the web, is held in the working position and the second is held in the open position as a reserve roll, the second work roll being driven at a low speed of rotation, and that for the purpose of servicing or replacing the first work roll, the second work roll is brought approximately to the same peripheral speed as the base roll and is then moved to its working position and, substantially simultaneously, the first work roll is moved into its open position.

2. A method according to claim 1, characterized in that the first and second work rolls are work rolls associated with the same base roll.

3. A method according to claim 1 or claim 2, characterized in that a replacement first work roll serves as reserve roll after the exchange of rolls.

4. A method according to claim 3, characterized in that two work rolls are used alternately as reserve rolls.

5. A method according to any one of the preceding claims, characterized in that the second work roll is held ready for operation in the open position.

6. A method according to any one of the preceding claims, in which the web bears with one side against at least one base roll and with its other side against at least one second base roll, characterized in that both for the first and for the second base roll at least one work roll is held in the open position as reserve roll.

7. A method of operating a web-rolling machine, substantially as described with reference to the accompanying drawings.

8. A web-rolling machine for carrying out the method according to any one of the preceding claims, the machine comprising at least one hard base roll; at least two elastic work rolls, each of which forms a nip with a base roll and which is movable by means of an adjusting device between a working position, in which it is pressed against the base roll, and an open position, in which it is spaced from the base roll, and to be brought by means of an adjustable drive to substantially the same peripheral speed as the base roll; and guide and directing members which are arranged to guide the web in such a manner that where a work roll is in the open position the web merely rests on the base roll, characterized in that at least one of two work rolls which in their working position effect substantially the same treatment of the web, is provided, for the purpose of serving as reserve roll, with a drive which has in addition a slow speed independent of the driving speed of the other work roll and of the base roll.

9. A machine according to claim 8, characterized in that the drive is in the form of a variable speed motor associated only with the respective work roll.

10. A machine according to claim 8 or claim 9, characterized in that the drive is provided with a controller to which the peripheral speed of the work roll is fed as an actual value and to which either a constant value for the slow speed or the peripheral speed of the base roll is fed as desired value.

11. A machine according to claim 10, characterized in that contactless sensors are provided for determining the peripheral speeds.

12. A machine according to any one of claims 8 to 11, characterized in that the adjusting device is provided with means having distance sensors for the purpose of guiding the work roll parallel to the base roll when it changes over from the open position to the working position.

13. A machine according to any one of claims 8 to 12, characterized in that the guide and directing members are disposed in such a manner that the web has, in use, the same area of contact on the base roll in each of the two work roll nips.

14. A machine according to any one of claims 8 to 13, characterized in that the guide and directing members are so disposed that in each of the two

work roll nips the entry angles and the exit angles of the web are, in use, identical to one another.

15. A machine according to claim 14, characterized in that the sum of the entry and exit angles is at most equal to 20°.

16. A machine according to any one of claims 8 to 15, characterized in that the guide and directing members are disposed in the same arrangement upstream and downstream of the two work roll nips.

17. A machine according to any one of claims 8 to 16, characterized in that each of the two work roll nips is preceded by an adjustable guide roller around which the web is, in use, wrapped over an angle of less than 90°, and which is arranged to apply to the web control and restoring forces directed transversely to the movement of the web.

18. A machine according to any one of claims 8 to 17, characterized in that a fixed directing roller is disposed downstream of both work roll nips.

19. A machine according to claim 18, characterized in that the directing rollers each form, in conjunction with a respective inserter roller with which it is adapted to be pressed into contact, a pair of draw rollers for the feeding of the web.

20. A machine according to any one of claims 8 to 19, in which two work rolls disposed diametrically opposite one another are associated with one base roll, characterized in that both work rolls have a drive providing a low speed.

21. A machine according to any one of claims 8 to 19, characterized in that three or more work rolls, of which at least one has a drive providing a low speed, are associated with a common base roll.

22. A machine according to any one of claims 8 to 19, characterized in that between two base rolls, each of which is provided with at least one work roll of its own, another, common work roll is disposed which has a drive providing a low speed and which is adapted to be moved out of a central open position towards either one of the two base rolls.

23. A machine according to any one of claims 8 to 22, characterized in that the work rolls are each provided with a deformation control device.

24. A machine according to claims 21 and 23, characterized in that the deformation control device is incorporated in the common work roll and is adapted to be turned through 180°.

25. A machine according to any one of claims 8 to 23, characterized in that a deformation control and pressing roll are provided on that side of each of the work rolls which is remote from the base roll.

26. A machine according to any one of claims 8 to 25, characterized in that the arrangement is such that, in use, the web passes directly through all the work roll nips of a base roll in succession.

27. A machine according to any one of claims 8 to 26, having at least one first base roll, against which, in use, one side of the web lies, and at least one second base roll, against which the other side of the web lies, characterized in that at least one work roll, whose drive provides a low speed, is provided for each of the first and second base rolls, respectively.

28. A machine according to any one of claims 8 to 27, characterized in that a second work roll is disposed in the path of the web between at least two first work rolls.

29. A web-rolling machine substantially as described with reference to any one of the examples illustrated in the accompanying drawings.

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